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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Applicants:	Eric A. Jacobsen	§	Art Unit:	2662
		§		
Serial No.:	09/855,132	§		
		§	Examiner:	Dmitry Levitan
Filed:	May 14, 2001	§		
		§		
Title:	TECHNIQUE FOR CONTINUOUS OFDM MODULATION	§ § §	Docket No.	ITL.0548US (P11107)

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPEAL BRIEF

Dear Sir:

Applicant hereby appeals from the Final Rejection dated March 3, 2004, finally rejecting claims 1-30.

I. REAL PARTY IN INTEREST

The real party in interest is Intel Corporation, the assignee of the present application by virtue of the assignment recorded at Reel/Frame 011810/0552.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

Date of Deposit April 8, 2004
I hereby certify under 37 CFR 1.8(a) that this correspondence is being deposited with the United States Postal Service as **first class mail** with sufficient postage on the date indicated above and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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III. STATUS OF THE CLAIMS

The application was originally filed with claims 1-30, which have been finally rejected and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

The amendments to the specification submitted in the Reply to Final Office filed on March 17, 2004 was not entered by the Examiner, as indicated in the Advisory Action. There are no other unentered amendments.

V. SUMMARY OF THE INVENTION

Referring to Fig. 1, an embodiment 10 of an OFDMA transmitter in accordance with the invention receives data to be transmitted over a communication link, such as a cable-based or wireless link, as examples. As an example, referring also to Fig. 11, the transmitter 10 may be used as part of a receiver 204 /transmitter 10 pair 209 (two shown in Fig. 11, as an example) in a wireless communication system 200, such as a wireless local area network (LAN), for example. Specification, p. 3.

As part of the wireless communication system 200, the transmitter 10 is assigned a subset of OFDM subcarriers for use in transmitting the data over a wireless link 203 to other wireless devices 205. In this manner, the assigned subset of OFDM subcarriers may be used to communicate data associated with a particular user, terminal or electrical device 210 that is coupled to the pair 209 for purposes of communicating over the wireless link 203. Specification, p. 3.

Referring to Fig. 1, during its course of operation, an encoder 12 of the transmitter

10 receives data (via communication lines 11) to be transmitted over the wireless link 203 (Fig. 11), and this data is updated at a predefined sampling rate. The encoder 12 may, for example, introduce an error correcting scheme into the data. The encoder 12 may also perform other operations on the received data, such as a mapping operation, for example. More specifically, the encoder 12 may map the data received by the encoder 12 into a complex value space using quadrature amplitude modulation (QAM). Other and different operations by the encoder 12 are possible. Specification, p. 3.

The encoder 12 provides the encoded data (via communication lines 13) to an Inverse Discrete Fourier Transform (IDFT) engine 14 of the transmitter 10. The IDFT engine 14 includes a processor 31 that executes instructions 33 that, in turn, are stored in a memory 35 of the IDFT engine 14. The encoded data may be viewed as being divided into segments, with each segment representing a coefficient that is associated with one of the assigned subcarriers. Specification, p. 3.

As described below, the IDFT engine 14 modulates these coefficients with the assigned subcarriers to produce a time-varying digital signal. This digital signal, in turn, is communicated (via communication lines 19) to a digital-to-analog converter (DAC) 20 that converts the digital signal into an analog signal. Analog transmission circuitry 23 subsequently modulates this analog signal with at least one radio frequency (RF) carrier signal and transmits the resultant RF signal by driving an antenna 44 in response to the RF signal. Specification, pp. 3-4.

The digital signal that is produced by the IDFT engine 14 forms the information for OFDM symbols that are indicated by the signal that is transmitted by the antenna 44.

In this manner, each basic OFDM symbol is formed from an N point IDFT and has a duration that is equal to a periodic rate at which the OFDM symbols are generated. When viewed in the frequency domain, each basic OFDM symbol includes sinc functions that are located at the frequencies of the OFDM subcarriers. Specification, p. 4.

Because the transmitted OFDM symbols may travel along different paths, interference may occur between symbols that are transmitted at different times. This interference, in turn, may degrade the orthogonality of the OFDM modulation and as a result, may prevent full recovery of the transmitted data. To prevent this interference, the IDFT engine 14 extends the length of the basic OFDM symbol by a guard interval, an extension that extends the current OFDM symbol's transmission beyond the time when a reflected previously transmitted OFDM symbol would interfere. The generation of the guard interval is discussed below. Specification, p. 4.

The IDFT engine 14 differs from its inverse Fast Fourier Transform (IFFT) counterpart that is found in a conventional OFDMA transmitter. In this manner, a conventional OFDM transmitter uses the IFFT to calculate the IDFT, as for certain conditions the IFFT uses symmetry to reduce the number of required mathematical operations to compute the IDFT. The IFFT requires, however, an IFFT input data vector that contains coefficients for all of the OFDM subcarriers, regardless if fewer than all of the subcarriers are assigned for purposes of modulation by the transmitter 10. The traditional OFDM transmitter accommodates this scenario by using zero values in the IFFT input data vector for the coefficients that are associated with unassigned subcarriers. However, this conventional technique requires that mathematical operations

(multiplication and accumulation operations, for example) still have to be performed in connection with these non-assigned subcarriers, resulting in numerous zero result computations and inefficient modulation. Specification, p. 4.

In contrast to a conventional OFDMA transmitter, the transmitter 10 uses the IDFT engine 14 that, in its computation of the IDFT, only performs mathematical operations that are associated with assigned subcarriers and does not perform such mathematical operations that are associated with unassigned subcarriers. Thus, the IDFT engine 14 performs continuous OFDM modulation. Specification, pp. 4-5.

To further illustrate this difference, Fig. 2 depicts the generation of an OFDM symbol 50 using the conventional IFFT technique. As shown, in the prior art, data 62 for assigned subcarriers is passed into an IFFT engine 56 that generates a cyclic prefix 52 as well as the basic OFDM symbol 54. The duration of the basic OFDM symbol 54 defines the period of OFDM signal generation. Zero value data 60 for unassigned subcarriers completes the IFFT input vector for the IFFT engine 56. Specification, p. 5.

The event of the mathematical operations that are performed in conventional OFDMA transmitters because of the processing of zero value coefficients for the non-assigned subcarriers becomes apparent when a signal flow diagram of the IFFT is examined. For example, Fig. 3 depicts a signal flow diagram for the computation of an inverse radix-two IFFT. As shown, for an eight-point IFFT, three stages 82, 84 and 86 are required to compute the IFFT. Additional stages must be added to compute a larger IFFT. As depicted in Fig. 3, each discrete output value from the last stage 86 depends on every input coefficient. Thus, introducing a zero value for one of the input coefficients produces

a significant number of mathematical operations that produce a value of zero. Specification, p. 5.

In contrast to the conventional OFDMA transmitter, the transmitter 10 includes the IDFT engine 14 that calculates discrete time values (called x_n) pursuant to the following expression:

$$x_n = \sum_{f=0}^{N-1} X_f \cdot e^{-j2\pi fn/N}, \quad \text{Equation 1}$$

where "f" is an integer representing a discrete subcarrier frequency index (and thus, each different value for "f" references a different subcarrier); "N" represents the length of the IDFT and the number of subcarriers; and "X_f" represents the coefficients (of the IDFT input vector) to be modulated. The expression "$e^{-2\pi fn/N}$" represents a complex exponential value that is associated with a particular subcarrier, as selected by the "f" index. Thus, the coefficient "X_1," for example, is associated with a subcarrier that is referenced by a "1" for the "f" index. Specification, p. 5.

Using Equation 1, the IDFT engine 14 calculates each x_n discrete value by performing mathematical operations (multiply and accumulate operations, for example) only with the X_f coefficients components that are associated with assigned subcarriers. Referring to Fig. 4, in this manner, to compute the IDFT for a particular x_n value, a maximum of N multiply operations 92 are needed, and the results of the operations 92 are accumulated as indicated by reference numeral 94. However, the IDFT engine 14 selectively performs these multiply operations 92, as the operations 92 that are associated with non-assigned subcarriers are skipped. Specification, pp. 5-6.

For example, if the subcarrier that is associated with a "f" index of "1" is not assigned, then the IDFT engine 14 does not perform the multiply operation 92a in the calculation of any of the x_n values. Not only are "n" multiply operations not performed for this example, accumulate operations to accumulate zero value multiplication results are also not performed, thereby resulting in more efficient modulation. Specification, p. 6.

Thus, the IDFT engine 14 may, in some embodiments of the invention, use a technique 100 that is depicted in Fig. 5 for the calculation of each x_n value. To perform the technique 100, as well as other techniques described herein, the processor 31 of the IDFT engine 14 may execute the instructions 33 (see Fig. 1) that are stored in the memory 35. In the technique 100, the IDFT engine 14 initializes (block 101) the "f" index to zero and determines (block 102) the subcarriers that have been assigned to the transmitter 10 for purposes of modulating data that is received by the transmitter 10. In this manner, the transmitter 10 is assigned a subset of the OFDM subcarriers that are available for communication over the wireless link 203 (see Fig. 11), and this subset may be dynamically reassigned. The IDFT engine 14 may receive an indication of the current assigned subset via communication lines 243 (see Fig. 1) that are coupled to the OFDM receiver 204 (part of the OFDM receiver transmitter pair 209) that decodes received information indicating reallocation of the subcarriers. Specification, p. 6.

Subsequently, in the technique 100, the IDFT engine 14 determines (diamond 104) whether the subcarrier that is associated with the current value of the "f" index is assigned. If not, then control transfers to block 110 where the "f" frequency index is incremented by one. If the subcarrier that is associated with the current value of the "f"

index is assigned, then the IDFT engine 14 calculates (block 106) the next component of the x_n value by multiplying the complex exponential (see Eq. 1) that is indexed by the "f" index with the appropriate coefficient. Subsequently, the IDFT engine 14 adds (block 108) this component of the x_n value to the other computed components, and control returns to block 110 where the "f" frequency index is incremented by one. Specification, pp. 6-7.

Next, the IDFT engine 14 determines (diamond 111) by examining the value of the "f" frequency index whether all components of the IDFT have been calculated. If not, control returns to diamond 104. Otherwise, the IDFT engine 14 terminates the routine 100, as the value of a particular x_n value has been computed. Thus, the IDFT engine 14 uses the technique 100 to calculate each x_n value. Specification, p. 7.

As an example, a table 112 in Fig. 6 depicts a comparison of the technique 100 used by the IDFT engine 14 with Radix-2 IFFT computations. In particular, the entries in column 113 are different numbers of available OFDM subcarriers (assigned and unassigned); the entries in column 114 are the numbers of computations required by the Radix-2 IFFT computations for the different available OFDM subcarriers; and the entries of column 116 define points where the calculations of the IDFT engine 14 are more efficient than the calculations of the Radix-2 IFFT. In this manner, for the case where the number of assigned subcarriers (column 113) does not exceed the values indicated in column 116, the technique provided by the IDFT engine 14 provides a computational benefit over the conventional IFFT-based modulation. Specification, p. 7.

For example, if the total number of available subcarriers is sixty four (row 3 of

table 112), then as long as six or less subcarriers are assigned, the IDFT engine 14 is computationally more efficient than an engine that uses Radix-2 IFFT computations. Specification, p. 7.

Cyclic extensions of OFDM symbols are commonly used to provide guard intervals to combat channel multipath effects. The guard interval for a particular OFDM symbol may be inserted ahead of (called a cyclic prefix) or behind (called a cyclic extension) the basic OFDM symbol. However, regardless of whether a cyclic prefix or extension is added, either scheme may be simplified using the technique used by the IDFT engine 14, as described below. Specification, p. 7.

For example, in some embodiments of the invention, the IDFT engine 14 creates a cyclic extension by generating x_n discrete values for values of "n" that exceed "N." In other words, the symbol generation extends beyond the period that is defined by the rate at which the basic OFDM symbols (without guard intervals) are generated. Specification, p. 7.

For example, Fig. 7 depicts a real component 120 and an imaginary component 122 of one subcarrier and a real component 124 and an imaginary component 126 of another subcarrier. Initially, the phases of these subcarriers are aligned, and when "n" is equal to "N" (two hundred seventy five, for example), as indicated by the vertical line 125, the interval in which the basic OFDM symbol is generated has elapsed. However, as shown, the IDFT engine 14 continues the IDFT beyond that interval to generate the cyclic extension. Specification, pp. 7-8.

Thus, in some embodiments of the invention, the IDFT engine 14 may use a

technique 130 (see Fig. 8) to generate the x_n values and generate the cyclic extension. In this manner, in the technique 130, the IDFT engine 14 determines (diamond 132) whether "n" is equal to "N." If so, the IDFT engine 14 determines (diamond 134) whether a cyclic extension is to be generated, and if so, the IDFT engine 14 determines (diamond 135) whether "n" is equal to "M," an index used to indicate the end of the cyclic extension. Specification, p. 8.

If "n" is less than "N" for the case where no cyclic extension is to be generated or "n" is less than "M" for the case where a cyclic extension is to be generated, then the IDFT engine 14 proceeds to block 136. Otherwise, all of the x_n values for the current OFDM symbol have been generated, and the technique 130 is terminated. In block 136, the IDFT engine 14 computes the x_n value in accordance with the technique 100 described above. Next, the IDFT engine 14 increments (block 138) "n" by one and control returns to diamond 132. Specification, p. 8.

Fig. 9 depicts a scenario in which the IDFT engine 14 appends a cyclic prefix to the basic OFDM symbol. In this manner, Fig. 9 depicts a real component 151 and an imaginary component 152 of one subcarrier and a real component 154 and an imaginary component 156 of another subcarrier. The phases of the subcarriers are aligned beginning with "n" being equal to approximately twenty five (for this example), as indicated by a vertical line 150. Thus, from the time from when "n=0" to when "n=25," the IDFT engine 14 generates a cyclic prefix. Specification, p. 8.

In some embodiments of the invention, the IDFT engine 14 generates the cyclic prefix by rotating the frequencies of the subcarriers. For example, if the cyclic prefix is

ten percent of the length of the OFDM generation interval, then the IDFT engine 14 selectively pre-rotates the phase of each subcarrier by $-2\pi \cdot 0.1 \cdot n \cdot f$ radians, where "f" is the frequency index defined above and "n" is an integer. Specification, p. 8.

Thus, to generate the cyclic prefix, in some embodiments of the invention, the IDFT engine 14 performs a technique 170 that is depicted in Fig. 10. In the technique 170, the IDFT engine 14 determines (diamond 172) whether a cyclic prefix is to be generated. If so, then the IDFT engine 14 determines (diamond 174) the needed rotation of the subcarrier frequencies and then subsequently rotates (block 175) the subcarrier frequencies by the determined amount. Specification, pp. 8-9.

In some embodiments of the invention, the IDFT engine 14 may also perform symbol shaping to reduce sidelobes in the frequency domain. Conventional transmitters may perform such symbol shaping by applying a weighting function (a Raised-Cosine function) in the time domain. However, instead of applying a weighting function in the time domain, the IDFT engine 14 may, in some embodiments of the invention, apply the weighting function in the frequency domain due to the commutativity of the multiplication operations used by the IDFT engine 14. In this manner, as described above, for each x_n value, the IDFT described above multiplies a coefficient that is associated with a particular subcarrier frequency with a complex exponential function that is associated with the subcarrier frequency. Thus, to apply a weighting function, each coefficient may be scaled according to the weighting function to apply the weighting function in the frequency domain. Specification, p. 9.

Alternatively, the weighting function may be applied in the time domain before

the IDFT, thereby providing another advantage to the technique that is described herein. Specification, p. 9.

Other embodiments are within the scope of the following claims. For example, although an IDFT is described for purposes of modulation, a DFT instead of the IDFT may be used for modulation using the zero data skipping technique that is described above. In this manner, for these embodiments, the receiver that receives the OFDM symbols uses an IDFT engine for purposes of demodulation. Thus, the term "discrete frequency transformation," as used in the context of this application, may mean either a discrete frequency transformation or an inverse discrete frequency transformation. Specification, p. 9.

VI. ISSUES

A. Can claims 1-30 be rejected under 35 U.S.C. § 112, second paragraph when the claims set forth the subject matter that Applicants regard as their invention and the claims particularly point out and distinctly define the metes and bounds of the subject matter that will be protected by the patent grant?

B. Can claims 1-7, 9 and 10 be anticipated and claim 8 be rendered obvious when the cited reference fails to teach all of the limitations of independent claim 1?

C. Can claims 11-17, 19 and 20 be anticipated and claim 18 be rendered obvious when the cited reference fails to teach all of the limitations of independent claim 11?

D. Can claims 21-27, 29 and 30 be anticipated and claim 28 be rendered obvious when the cited reference fails to teach all of the limitations of independent claim 21?

E. Can claims 9, 19 and 29 be anticipated when the cited reference fails to teach all claim limitations?

VII. GROUPING OF THE CLAIMS

Claims 1-8 and 10 can be grouped together; claims 11-18 and 20 can be grouped together; claims 21-28 and 30 can be grouped together; and claims 9, 19 and 29 can be grouped together. With this grouping, all claims of a particular group stand or fall together. Furthermore, regardless of the grouping that is set forth by the Examiner's rejections, the claims of each group set forth in this section stand alone with respect to the claims of the other groups that are set forth in this section. In other words, any claim of a particular group that is set forth in this section does not stand or fall together with any claim of any other group that is set forth in this section.

VIII. ARGUMENT

All claims should be allowed and thus, overcome the Examiner's rejections for the reasons that are set forth below.

A. Can claims 1-30 be rejected under 35 U.S.C. § 112, second paragraph when the claims set forth the subject matter that Applicants regard as their invention and the claims particularly point out and distinctly define the metes and bounds of the subject matter that will be protected by the patent grant?

Independent claims 1, 11 and 21 contain the phrase "discrete frequency transformation." Due to the inclusion of this language, the Examiner rejects independent claims 1, 11 and 21 and dependent claims 2-10 (that depends from claim 1), 12-20 (that depend from claim 11), and 22-30 (that depend from claim 21) under the second

paragraph of 35 U.S.C. § 112. As a basis for these § 112 rejections, the Examiner states, "the limitation 'discrete frequency transformation' is unclear, because it is not described in the specification or well known in the art." Final Office Action, 2.

It is noted at the outset that if the Examiner contends that support for the limitation "discrete frequency transformation" does not appear in the specification, then the Examiner should have rejected the claims under the first paragraph of 35 U.S.C. § 112. The test to determine whether a particular claim term complies with the second paragraph of section 112 requires the determination that a.) the claims set forth subject matter that applicants regard as their invention; and b.) the claims must particularly point out and distinctly define the metes and bounds of the subject matter that will be protected by the patent grant. M.P.E.P. § 2171. The Examiner has failed to show why the claims and thus, the phrase "discrete frequency transformation" fails to satisfy either of these requirements. Thus, for at least this reason, the § 112, second paragraph rejections of claims 1-30 are improper. (1)

Additionally, lines 19-25 on page 9 of the specification make it clear that the phrase "discrete frequency transformation" may refer to either to an Inverse Discrete Fourier Transformation or a Discrete Fourier Transformation. It is noted that lines 23-25 on page 9 of the specification incorrectly refer to a "DFT" as a discrete frequency transformation and refer to an "IDFT" as an inverse frequency transformation. An attempt was made to correct this typographical error in the Reply to Final Office Action that was filed on March 3, 2004. However, the Examiner refused to enter the amendment. However, the specification makes numerous references to a "DFT" meaning (2)

a discrete Fourier transform and a "IDFT" meaning an inverse discrete Fourier transform. Thus, in connection with the paragraph that appears in lines 19-25 on page 9 of the application, it is clear that the phrase "discrete frequency transformation" may refer either to an Inverse Discrete Fourier Transformation (IDFT) or a Discrete Fourier Transformation (DFT). Therefore, one skilled in the art would recognize that the "discrete frequency transformation" is a genus term that includes such species as an IDFT and a DFT. Applicant does not wish to limit the invention to being only directed to such discrete frequency transformations such as a DFT or only to an IDFT. Rather, Applicant desires to maintain the claim breadth by using the language discrete frequency transformation," as the Examiner fails to show a proper basis for sustaining the § 112, second paragraph rejections of claims 1-30. It appears that the Examiner maintains the § 112 rejections due to the breadth of "discrete frequency transformation." However, "claim breadth is not to be equated with indefiniteness." M.P.E.P. § 2172.03.

Thus, the § 112, second paragraph rejections of claims 1-30 are improper and should be reversed.

B. Can claims 1-7, 9 and 10 be anticipated and claim 8 be rendered obvious when the cited reference fails to teach all of the limitations of independent claim 1?

The method of independent claim 1 includes basing a discrete frequency transformation on the number of subcarriers in a predetermined set of subcarriers. One or more subcarriers of this set are assigned to modulate data, and the remaining subcarriers of the set are not assigned to modulate the data. The method includes performing the

discrete frequency transformation on the data to modulate the data and excluding from the transformation mathematical operations that are associated with the subcarriers that are not assigned to modulate the data.

The Examiner rejects independent claim 1 under 35 U.S.C. § 102(e) in view of U.S. Patent No. 6,175,550 (herein called "van Nee"). van Nee generally teaches a system that includes dynamic control circuitry 15 that performs an N-point IFFT. In addition to the N-point IFFT, van Nee discloses that the dynamic control circuitry 15 may perform an X-point IFFT, where X is less than the number (N) of subcarriers. *See, for example*, van Nee, 6:10-23.

Thus, although van Nee describes an X-point IFFT, this IFFT is based on an X number of subcarriers (i.e., a number less than N), not on N subcarriers.

The method of independent claim 1 recites that mathematical operations that are associated with subcarriers that are not assigned to modulate data are excluded from the discrete frequency transformation. Contrary to these limitations, van Nee fails to teach the exclusion of mathematical operations that are associated with subcarriers that are not assigned to modulate data. This exclusion of mathematical operations is neither explicit nor implicit from language that states that an X-point IFFT is being performed rather than N-point FFT. More specifically, if the X-point IFFT disclosed in van Nee were excluding mathematical operations that are associated with subcarriers that are not assigned to modulate data, then van Nee would describe this exclusion with respect to the X subcarriers. However, van Nee specifically states that the X-point IFFT is performed based on X subcarriers. Thus, van Nee fails to teach or suggest such an exclusion and

(1)

thus, fails to teach or even suggest all of the limitations of independent claim 1. Although van Nee describes leaving some input values in the IFFT transformation zero (van Nee 4:55-57), van Nee does not describe that the mathematical operations associated with these input values are excluded from the IFFT. In fact, this statement implies the opposite approach.

The Examiner contends that the "exclusion of mathematical operations associated with dropped carriers is an inherent part of van Nee's system." Final Office Action, 5. In support of this conclusion, the Examiner contends that van Nee generally teaches reduction of implementation complexity, and the Examiner makes the broad statement, "performing mathematical operation with no input (dropped carriers) is not an acceptable practice." Final Office Action, 5. Regarding the "reduction of implementation complexity" basis, the Examiner refers to line 20 in column 3 of van Nee to allegedly teach that dropping subcarriers would somehow reduce the implementation complexity. However, putting this language in the proper context, the language refers to varying the number of carriers, the symbol duration, the number of bits per symbol per carrier, the forward error correction coding scheme, the coding rate and the fraction of the symbol duration that is used as guard time. van Nee, 3:3-21. Nowhere, however, in this cited passage is there a discussion of reducing implementation complexity by excluding mathematical operations that are associated with subcarriers that are not assigned to modulate data.

For a limitation to be inherent in a reference, the limitation must <u>necessarily flow</u> from the reference. M.P.E.P. § 2122; *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat.

App. & Inter. 1990). The Examiner has made no showing why the omission of mathematical operations associated with subcarriers that are not being used are necessarily excluded from the IFFT that is described in van Nee. In this manner, the Examiner, "must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic <u>necessarily</u> flows from the teachings of the applied art." *Ex parte Levy*, 17 USPQ2d at 1464; M.P.E.P. § 2122. Not only do the missing claim limitations fail to necessarily flow from van Nee, a clear alternative exists, i.e., the alternative of performing mathematical operations with zero input subcarriers. The recognition that the exclusion of the mathematical operations would enhance performance is based solely on the hindsight gleaned from the current application. However, the Examiner fails to show why the missing claim limitations necessarily flow from van Nee. Thus, van Nee fails to implicitly, inherently or explicitly teach all of the limitations of independent claim 1. Claims 2-10 are patentable for at least the reason that these claims depend from an allowance. (2) (3)

Therefore, the §§ 102 and 103 rejections of claims 1-10 are improper and should be reversed.

C. Can claims 11-17, 19 and 20 be anticipated and claim 18 be rendered obvious when the cited reference fails to teach all of the limitations of independent claim 11?

The system of independent claim 11 includes a device to generate data to be modulated and a transmitter. The transmitter bases a discrete frequency transformation on the number of subcarriers in a predetermined set of subcarriers. One or more

subcarriers of the set of subcarriers are assigned to modulate data, and the remaining subcarriers of the set are not assigned to modulate the data. The transmitter performs the discrete frequency transformation on the data to modulate the data and excludes from the transformation mathematical operations that are associated with the subcarriers that are not assigned to modulate the data.

The Examiner rejects independent claim 11 under 35 U.S.C. § 102(e) as being anticipated by van Nee. However, van Nee fails to teach the transmitter of claim 11.

More specifically, the transmitter of claim 11 excludes from a discrete frequency transformation mathematical operations that are associated with subcarriers that are not assigned to modulate data. Contrary to the transmitter of claim 11, van Nee discloses dynamic control circuitry 15 that performs either an N-point IFFT or an X-point IFFT, where X is less than N. Thus, van Nee merely discloses an X-point IFFT instead of an N-point IFFT. This disclosure does not, however, teach the exclusion of mathematical operations from the X-point IFFT that are associated with subcarriers that are not assigned to modulate data. Furthermore, although van Nee describes leaving some input values in the IFFT transformation zero (van Nee, 4:55-57), van Nee does not describe that the mathematical operations that are associated with these input values are excluded from the IFFT. Thus, van Nee does not implicitly or explicitly teach the missing claim limitations. (4)

The Examiner contends that the missing claim limitations are inherent in van Nee. However, the Examiner fails to show why the missing claim limitations necessarily flow from van Nee. Instead, there is a clear alternative, i.e., performing mathematical

operations with the subcarriers being represented by zeros. Thus, the missing claim limitations are not inherent in van Nee.

Therefore, van Nee fails to implicitly, explicitly or inherently teach the transmitter of independent claim 11. Claims 12-20 are patentable for at least the reason that these claims depend from an allowable claim.

Thus, the §§ 102 and 103 rejections of claims 11-20 are improper and should be reversed.

D. Can claims 21-27, 29 and 30 be anticipated and claim 28 be rendered obvious when the cited reference fails to teach all of the limitations of independent claim 21?

The article of independent claim 21 includes a storage medium that is readable by a processor-based system. The storage medium stores instructions to cause a processor to base a discrete frequency transformation on the number of subcarriers in a predetermined set of subcarriers. One or more subcarriers of this set are assigned to modulate data, and the remaining subcarriers are not assigned to modulate the data. The instructions cause the processor to perform the discrete frequency transformation on the data to modulate the data and exclude from the transformation mathematical operations that are associated with the subcarriers that are not assigned to modulate the data.

The Examiner rejects independent claim 21 under 35 U.S.C. § 102(e) in view of van Nee. However, van Nee fails to show instructions to cause a processor to exclude from a discrete frequency transformation mathematical operations that are associated with subcarriers that are not assigned to modulate data. Furthermore, the Examiner has 5

failed to show why these missing claim limitations necessarily flow from van Nee. To the contrary, a clear alternative exists, i.e., not excluding mathematical operations that are associated with subcarriers that are not assigned to modulate data from the IFFT. Therefore, van Nee neither explicitly, implicitly or inherently teaches all of the limitations of independent claim 21.

Claims 22-31 are patentable for at least the reason that these claims depend from an allowable claim.

Therefore, the §§ 102 and 103 rejections of claims 21-30 are improper and should be reversed.

E. Can claims 9, 19 and 29 be anticipated when the cited reference fails to teach all claim limitations?

Claim 9 depends from independent claim 1 and recites selectively pre-rotating phases of the one or more subcarriers that are assigned to modulate the data to generate a cyclic prefix. Claim 19 depends from independent claim 11 and recites that the transmitter selectively pre-rotates phases of the one or more subcarriers that are assigned to modulate the data to generate a cyclic prefix. Claim 29 depends from independent claim 21 and recites that the storage medium stores instructions to cause the processor to selectively pre-rotate phases of the one or more subcarriers that are assigned to modulate data to generate a cyclic prefix.

The Examiner rejects each of independent claims 9, 19 and 29 under 35 U.S.C. § 102(e) in view of van Nee. Applicants submit that these claims are patentable for at least

the reason that these claims depend from allowable independent claims 1, 11 and 21, respectively, for the reasons set forth above in Issues B, C and D. Claims 9, 19 and 29 are patentable for the additional, independent reason that is set forth below.

In the rejections of these claims, the Examiner refers to lines 31-43 in column 4 of van Nee. The Examiner contends that this language teaches using phase shift keying to generate a cyclic prefix 18. However, contrary to the Examiner's position, this cited language mentions "phase shift keying," but does not mention pre-rotating phases of one or more subcarriers and does not mention generating a cyclic prefix. Instead, the Examiner selectively reads van Nee to extract the phrase "phase shift keying" from column 14 and somehow combines this with the cyclic prefix and windowing block 18 that is depicted in Figure 1. However, Applicants submit that nowhere does van Nee disclose selectively pre-rotating phases of one or more subcarriers to generate a cyclic prefix. To the contrary, the only mentioning of the function of the block 18 is discussed in lines 24-40 of column 6 of van Nee. As can be seen from this language, there is no teaching or even a suggestion of selectively pre-rotating phases of one or more subcarriers that are assigned to modulate data to generate a cyclic prefix.

Thus, the § 102 rejections of claims 9, 19 and 29 are improper for at least these additional, independent reasons and should be reversed.

IX. CONCLUSION

Applicant requests that each of the final rejections be reversed and that the claims subject to this appeal be allowed to issue.

Respectfully submitted,

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APPENDIX OF CLAIMS

The claims on appeal are:

1. A method comprising:

basing a discrete frequency transformation on the number of subcarriers in a predetermined set of subcarriers, one or more subcarriers of the set assigned to modulate data and the remaining subcarriers of the set not assigned to modulate the data;

performing the discrete frequency transformation on the data to modulate the data; and

excluding from the transformation mathematical operations associated with the subcarriers not assigned to modulate the data.

2. The method of claim 1, wherein the excluding comprises:

excluding all of the subcarriers not assigned to modulate the data.

3. The method of claim 1, wherein the performing the discrete frequency transformation comprises:

performing orthogonal frequency division multiplexing modulation on the data.

4. The method of claim 1, wherein the performing comprises:

applying a weighting function during the discrete frequency transformation to perform symbol shaping.

5. The method of claim 1, wherein said one or more subcarriers are assigned to at least one of a user, an electrical device and a terminal.

6. The method of claim 1, further comprising:

using the modulated data to form an orthogonal frequency division multiplexing symbol.

7. The method of claim 1, further comprising:

using the transformation to generate symbols at a rate defined by a symbol generation interval;

basing the discrete frequency transformation on the symbol generation interval; and

using the discrete frequency transformation to generate discrete modulated values for an interval that exceeds the symbol generation interval to generate a cyclic extension.

8. The method of claim 7, further comprising:

transmitting each of the symbols during one of the intervals that exceeds the symbol generation interval.

9. The method of claim 1, further comprising:

selectively pre-rotating phases of said one or more subcarriers to generate a cyclic prefix.

10. The method of claim 1, wherein the mathematical operations comprise at least one of an accumulate operation and a multiplication operation.

11. A system comprising:

a device to generate data to be modulated; and

a transmitter to:

base a discrete frequency transformation on the number of subcarriers in a predetermined set of subcarriers, one or more subcarriers of the set of subcarriers assigned to modulate data and the remaining subcarriers of the set not assigned to modulate the data;

perform the discrete frequency transformation on the data to modulate the data; and

exclude from the transformation mathematical operations associated with the subcarriers not assigned to modulate the data.

12. The system of claim 11, wherein the transmitter excludes all of the subcarriers not assigned to modulate the data.

13. The system of claim 11, wherein the transmitter performs orthogonal frequency division multiplexing modulation on the data.

14. The system of claim 11, wherein the transmitter determines components of the discrete frequency transformation independently from each other.

15. The system of claim 11, wherein said one or more subcarriers are assigned to one of a user, an electrical device and a terminal.

16. The system of claim 11, wherein the transmitter uses the modulated data to form an orthogonal frequency division multiplexing symbol.

17. The system of claim 11, wherein the transmitter:

uses the transformation to generate symbols at a rate defined by a symbol generation interval;

bases the discrete frequency transformation on the symbol generation interval; and

uses the discrete frequency transformation to generate discrete modulated values for an interval that exceeds the symbol generation interval to generate a cyclic extension.

18. The system of claim 17, wherein the transmitter transmits each of the symbols during one of the intervals that exceeds the symbol generation interval.

19. The system of claim 11, wherein the transmitter selectively pre-rotates phases of said one or more subcarriers to generate a cyclic prefix.

20. The system of claim 11, wherein the mathematical operations comprise at least one of an accumulate operation and a multiplication operation.

21. An article comprising a storage medium readable by a processor-based system, the storage medium storing instructions to cause a processor to:

base a discrete frequency transformation on the number of subcarriers in a predetermined set of subcarriers, one or more subcarriers of the set assigned to modulate data and the remaining subcarriers not assigned to modulate the data;

perform the discrete frequency transformation on the data to modulate the data; and

exclude from the transformation mathematical operations associated with the subcarriers not assigned to modulate the data.

22. The article of claim 21, the storage medium storing instructions to cause the processor to exclude from the transformation all mathematical operations associated with the subcarriers not assigned to modulate the data.

23. The article of claim 21, the storage medium storing instructions to cause the processor to perform orthogonal frequency division multiplexing modulation on the data.

24. The article of claim 21, the storage medium storing instructions to cause the processor to determine components of the discrete frequency transformation independently from each other.

25. The article of claim 21, wherein said one or more subcarriers are assigned to one of a user, an electrical device and a terminal.

26. The article of claim 21, the storage medium storing instructions to cause the processor to use the modulated data to form an orthogonal frequency division multiplexing symbol.

27. The article of claim 21, the storage medium storing instructions to cause the processor to:

use the transformation to generate symbols at a rate defined by a symbol generation interval;

base the discrete frequency transformation on the symbol generation interval; and

use the discrete frequency transformation to generate discrete modulated values for an interval that exceeds the symbol generation interval to generate a cyclic extension.

28. The article of claim 27, the storage medium storing instructions to cause the processor to:

transmit each of the symbols during one of the intervals that exceeds the symbol generation interval.

29. The article of claim 21, the storage medium storing instructions to cause the processor to:

selectively pre-rotate phases of said one or more subcarriers to generate a cyclic prefix.

30. The article of claim 21, wherein the mathematical operations comprise at least one of an accumulate operation and a multiplication operation.

APR 1 3 2004
PATENT & TRADEMARK OFFICE

TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No.
ITL.0548US

In Re Application Of: Eric A. Jacobsen

Serial No.	Filing Date	Examiner	Group Art Unit
09/855,132	05/14/01	Dmitry Levitan	2662

Invention: Technique For Continuous OFDM Modulation

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TO THE COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

The fee for filing this Appeal Brief is: $330.00

- [x] A check in the amount of the fee is enclosed.
- [ ] The Director has already been authorized to charge fees in this application to a Deposit Account.
- [x] The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 20-1504

Signature

Dated: April 8, 2004

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I certify that this document and fee is being deposited on April 8, 2004 with the U.S. Postal Service as first class mail under 37 C.F.R. 1.8 and is addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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